

## Weather-Health Nursing & Bio-Meteorological Pre-Symptom Time Markers Nursing Innovations to Reduce Global Mortality/Morbidity

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### Abstract

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The purpose of this article is threefold. First, the need for and discovery of pre-symptom time markers for protective / preventative care associated with cardiac disease, stroke, respiratory disease, and diabetes are discussed. Secondly, a brief overview of the bio-meteorological research which discovered four concurrent pre-symptom time makers for each of these four populations is highlighted. Thirdly, a discussion of the why and how integration of bio-meteorological pre-symptom time markers into protective and preventative nursing care management can reduce global mortality and morbidity among cardiac, stroke, respiratory, and diabetic patients is emphasized. Application of this knowledge falls within the scope of professional nursing practice and will have its greatest impact potential if integrated within the practice of nursing. The proximity of nurses to cardiac, respiratory, and diabetic populations in homes, schools, clinics, occupational settings, hospitals, and tele health services enables timely interventions to fortify wellness prior to periods identified as having bio-meteorological vulnerability and risk. These bio-meteorological periods of vulnerability are repetitively seasonal and have real-time repetitive concurrency among cardiac, stroke, respiratory and diabetic populations residing in northern and southern hemisphere countries studied.

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**Keywords:** Nursing, nursing innovation, discovery, population health, bio-meteorology, cardiac disease, respiratory disease, stroke, diabetes, global health, mortality, morbidity, pre-symptom time markers, weather-health, weather-health dynamics

### Introduction

The purpose of this article is threefold. First, the need for and discovery of pre-symptom time markers for protective / preventative care associated with cardiac disease, stroke, respiratory disease, and diabetes (*the four populations*) are discussed. Secondly, a brief overview of the bio-meteorological research which discovered four concurrent pre-symptom time makers for each of these four populations is highlighted. Thirdly, a discussion of the why and how integration of bio-meteorological pre-symptom time markers into protective and preventative nursing care management can reduce global mortality and morbidity among cardiac, stroke, respiratory, and diabetic patients is emphasized.

### Cardiac Disease, Stroke, Respiratory Disease & Diabetes

According to the World Health Organization (WHO), non-communicable diseases or chronic diseases account for 63% of deaths and disability globally each year (WHO, 2015). By 2020, annual mortality rates for chronic diseases are predicted to near 73% world-wide (WHO, n.d. ). From the years 2000 to 2012, "ischemic heart disease, stroke, respiratory infections, and chronic obstructive pulmonary lung disease (COPD)" were the "top major killers" globally (WHO, 2014). Also during 2010, diabetes was ranked seventh among the 10 leading causes of death (WHO, 2014). Overall, the WHO considers "heart disease (heart attacks and stroke) chronic respiratory diseases, and diabetes three of the four leading non-communicable diseases (WHO, 2014).

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Persons among each of these populations experience degenerative conditions which can be managed and controlled but not cured (University of Michigan, 2011). Historically, the triggers for aggressive treatment have been the presence of adverse signs and symptoms. The presence of signs and/or symptoms gives evidence that a person's health is being compromised. Treating persons without objective measurable cause is considered wasteful and at times potentially harmful. The expression "don't fix it if it isn't broken" is an adage widely followed. However, during periods of wellness, persons with a chronic disease / condition are likely to have lower tolerance thresholds to stressors. In addition, a person with a chronic condition is likely to have lower resilience reducing the person's physical ability to recover or bounce back from the effects of minor stressors. Therefore, fortification of health status prior to anticipated vulnerable exposures and minimizing the degree of vulnerable exposures together can and has reduced and/or mitigated exposure risk (Met Office, 2015).

### **Ambulatory Care Sensitive Conditions (Acsc): Same Populations**

In the United States, hypertension (the leading cause of stroke), congestive heart failure, COPD, and diabetic conditions are recognized by the Agency for Healthcare Research and Quality (AHRQ, 2014), as ambulatory care sensitive conditions. Ambulatory care sensitive conditions (ACSC) are those for which *timely* ambulatory care can potentially prevent unnecessary hospitalizations. AHRQ notes that "while not all admissions for these conditions are avoidable, it is assumed that appropriate ambulatory care could prevent onset of this type of illness or condition, ..." and "control acute episodic illness or condition, or manage a chronic disease or condition" (National Quality Measure Clearinghouse, 2014.). Interestingly, the four leading causes of global mortality and morbidity are an overlay of the ACSCs: hypertension, heart failure, COPD, and diabetes. At this time, the AHRQ uses the annual incidence of ACSC hospital admissions for hypertension, heart failure, COPD, and diabetes as Primary Quality Indicator (PQI) measurements. PQI trends serve to guide Medicare financial incentives and penalties for U.S. primary care service agencies and hospitals (Rau, J., 2012). Given, hypertension, heart failure,

COPD and diabetes are each:

- 1) Major causes of annual global deaths
- 2) Avoidable with early quality treatment
- 3) Influential in personal and societal welfare

The need to improve health fortification and minimize risk for these populations is a priority.

### **Health Fortification & Minimization of Risk: What is Needed?**

Healthcare literature provides evidenced based protocols for the treatment of; cardiac conditions, stroke, respiratory disease, and diabetes. Preventative care measures to reduce the likelihood of an exacerbations for; cardiac disease, stroke, respiratory disease, and diabetes are also documented. Lacking in the healthcare literature for cardiac disease, stroke, respiratory, and diabetes are guide lines for 1) strategic timing of pre-symptom protective and preventative measures to extend periods of wellness, and 2) an integration of knowledge related to antecedent events/condition/exposures associated with peaks and troughs in mortality and morbidity. Essentially, identification of factors aligned with wellness and factors aligned with mortality and morbidity can provide insight into strategies for reducing exacerbation risk. Important discoveries regarding associations between bio-meteorological conditions and cardiac, stroke, respiratory and diabetic mortality / morbidity trends follow.

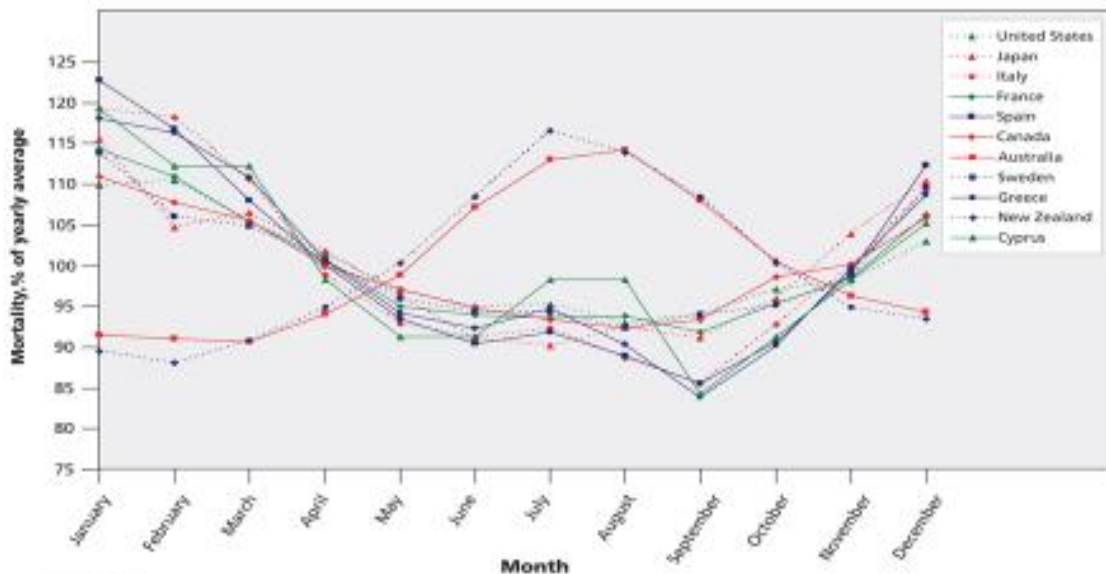
### **Two Global Repetitive Seasonal Mortality Time-Markers**

Global repetitive "all cause" mortality trends have been discovered for northern and southern hemisphere countries. "All cause "national monthly mortality statistics were analyzed from eleven different country national datasets (Falagas, M., Karageorgopoulos, D.E., Moraitis, L, I., Vouloumanou, E.K., Roussos, N., Peppas, G., Rafailides, P.I., 2009).

## Seasonal Mortality Trends:

Northern Hemisphere & Southern Highest Winter Months

Northern & Southern Hemisphere Lowest Last Summer Month & 1st Fall Month



### Reference

Falagas, M.E., Karageorgopoulos, D.E., Moraitis, L.I., Vouloumanou, E.K., Roussos, N., Peppas, G., Rafailidis, P.I. 2009. Seasonality of mortality: the September phenomenon in Mediterranean countries. *Canadian Medical Association Journal* **181**: 484-6.

Both northern and southern hemisphere countries experienced highest monthly mortalities during their respective winter months and lowest incidences of national mortality rates occurs toward the end of the summer season (Falagas et al, 2009). National datasets were derived from monthly records which varied in time span. For example, Japan's national dataset was the smallest time frame spanning only two years of monthly mortality averages. Italy's dataset was the largest and averaged monthly mortality for over 50 consecutive years (Falagas et al, 2009).

### Repetitive Concurrent Mortality / Morbidity Peaks & Troughs: Cardiac Disease, Stroke, Respiratory Disease, & Diabetes– Two Diagnostic Related Time-Makers

Multiple research studies in the bio-meteorological literature indicate repetitive on current mortality and morbidity trends for all cause, cardiac disease, stroke, respiratory disease, and diabetes among northern and southern hemisphere country populations studied (See Figure 1) (Reichert, T.A., Simonsen, L., Sharma, A., Pardo, S.A., Fedon, D.S., & Miller, M.A., 2004; Feldman, D.E., Platt, R., Deryl, V., Kapetanakis, C., Lamontagnel, D., Ducharme, A., Gianetti, N., Frenette, M., & Beck, E.J., 2004; Boulay, F., Berthier, F., Sisteron, O., Gendreike, Y., & Gibelin, P., 1999; Crombie, D.L., Fleming, D.M., Cross, K.W., & Lancashire, R.J., 1995). One or more weather-health studies addressed re-occurring mortality and/or morbidity patterns among the following countries: Australia, Canada, Chile, Cyprus, Denmark, France, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Poland, Portugal, Republic of

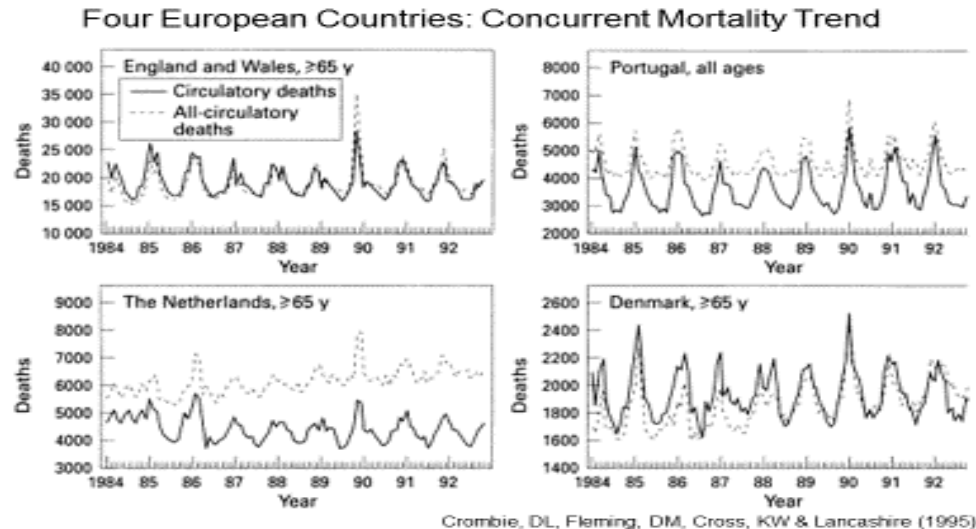


Figure 3 Deaths due to circulatory causes compared with those due to all causes minus circulatory causes. Monthly data 1984-92.

Seychelles, Republic of South Africa, Singapore Spain, Sweden, Switzerland, Taiwan, United States of America, and the United Kingdom. Each study demonstrated near concurrent repetitive peaks and troughs in national monthly incidences of mortality and/or morbidity (Marti-Soler, 2014; Medina-Ramos & Schwartz, 2007; Healy, 2003; Belay et al, 1999; Crombie et al, 1995). Essentially, seasonal trends were repetitive while episodic peaks and troughs for all four chronic conditions peaked and troughed in near unison year after year. The month of peaks and troughs may change each year. However, when the peak month changes for one chronic disease category, the peak month changed for all categories (i.e. all cause, cardiac, stroke, respiratory and diabetic conditions) during that same year (See Figures 2 and 3). The evidence strongly suggests that the highs and lows of incidences of people with cardiac disease, stroke, respiratory disease, and diabetes becoming sick and dying demonstrate common concurrent reoccurring patterns world-wide.

### Nightingale Emphasized Environmental Nursing Model

The environmental nurse theorist Florence Nightingale (1860) graphed identical mortality and morbidity patterns over 100 years ago (See Figure 4). In response to available evidence, Nightingale directed future nurses to consider bio-meteorological phenomena when assessing the need for nursing, as well as, when designing nursing interventions. Nightingale's (1860) bio-meteorological recommendations are noted below:

In watching diseases, both in private houses and in public hospitals, the thing which strikes the experienced observer most forcibly is this, that the symptoms or the sufferings generally considered to be inevitable and incident to the disease are very often not symptoms of the disease at all, but of something quite different—of the want of fresh air, or of light, or of warmth, ... And this quite as much in private as in hospital nursing.

Of the sufferings of disease, disease not always the cause. (Nightingale, 1860)

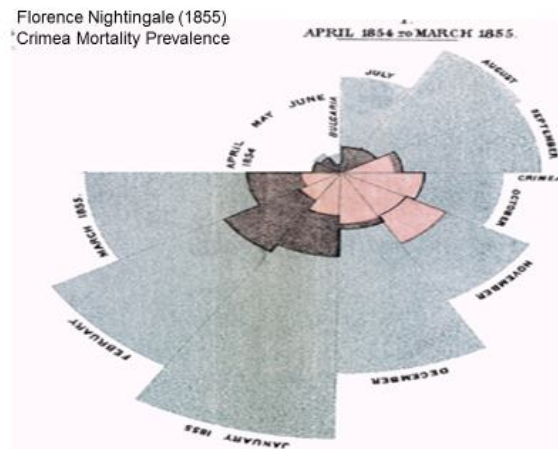
... If a patient is cold, if a patient is feverish, if a patient is faint, if he is sick after taking food, if he has a bed-sore, it is generally the fault not of the disease, but of the nursing.

I use the word nursing for want of a better. It has been limited to signify little more than the administration of medicines and the application of poultices. It ought to signify the proper use of fresh air, light, warmth, cleanliness, quiet, and the proper selection and administration of diet—all at the least expense of vital power to the patient.

What nursing ought to do.

Nightingale, F (1859) Notes on Nursing: What it is, what it is not

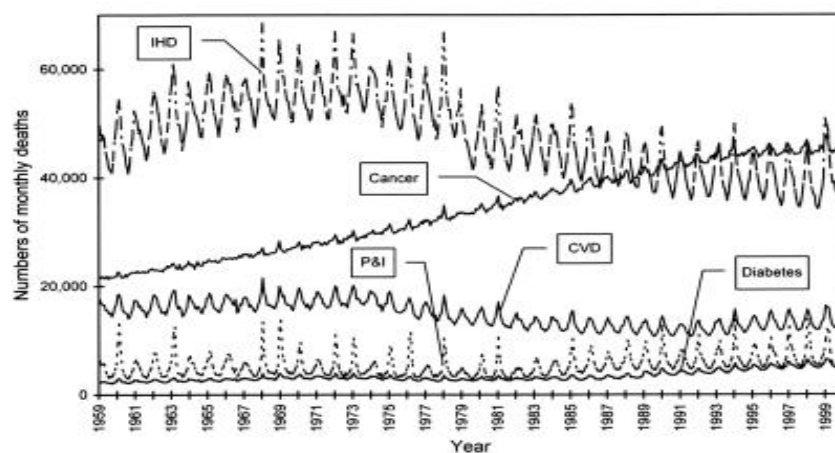
Figure 4



Nightingale's (1859) clinical tabulations concur with the interpretation of Crombie et al (1995) following a review of four national monthly mortality datasets from England and Wales (9 years, 51 weeks), Netherlands (10 years), Denmark (10 years), and Portugal (10 years). Crombie et al (1995) concluded "there are a common set of causal factors that impacts on the underlying causes regardless of causal categories ... assigned" (Crombie et al, 1995, p. 375). Essentially, Crombie et al (1995) questioned why populations were dying from various causes at about the same time year after year? Could unidentified causes contribute to the concurrence of monthly variations in mortality? The bio-meteorological investigation of Reichert et al (2004) suggests that seasonal changes and weather have a "timing and modulating" effect on human mortality and morbidity. According to Reichert et al (2004) the cause of excess winter deaths is linked to the incidences of influenza and pneumonia. Collectively, bio-meteorological re-occurring trends identify seasonal vulnerability patterns and "red flag trends" indicating the need for protective and preventative nursing care for ischemic heart disease, pneumonia and influenza, cerebral vascular disease, and diabetic populations. Cancer populations studied did not follow seasonal trends.

Figure 5

FIGURE 1. Monthly numbers of deaths attributed to five classes of disease in the United States during the period 1959–1999.



Thomas A. Reichert et al. *Am. J. Epidemiol.* 2004;160:492-502

### **Pre-Symptom Time Makers Important to Nursing Care – Why**

Pre-symptom time markers signify when health fortification behaviors and exposure protective modalities should be strategically implemented. For example, adherence to prescribed programs of care are to be followed as designed. However, over time, care adherence may be less rigorously followed in absence of signs and symptoms. Also, episodically a person diagnosed with cardiac, hypertensive, respiratory, and/or diabetes who has remained stable, may elect to stray from their care regime given special circumstances (i.e. a party or family event). Taking bio-meteorological risks into account enables self-care agents to better weigh the choice of care program deviations or momentary non-adherence.

### **Pre-Symptom Time Makers & Nursing Care Delivery – How**

Nursing curriculums need to integrate a basic understanding of seasonal climatic changes and common weather variable parameters and shifts including: temperature, barometric pressure, precipitation, and humidity. In the US, local annual geographic weather variable area norms are available from each Office of the State Climatologist. Annual norms and day to day weather variable readings are used by other industries to accommodate local seasonal and day to day atmospheric characteristic changes within local environments. Continuous local weather measurements are available online. As the air continually circulates through geographic regions, the exposure qualities of the moving air continuously change. Most nurses are not aware that a patient in a patient room experiences significant air changes. For example, as room air pressure changes 1) room air oxygen percentage levels change, 2) the weight of the air against the human body changes, 3) gas volumes in body air spaces change. Room air humidity levels and room air temperatures can change. Each environmental change requires human body compensation to maintain internal homeostasis. Generally, seasonal and day to day acclimation workload shifts are accommodated by a healthy human body. Consider an average 1% change in room air oxygen. Daily a 1% +/- change in room air oxygen is compensated by a reciprocal 1% change in respiratory function (i.e. automatically the body may increase or decrease the respiratory rate from a range between 16 to 17 breathes / minute or increase/decrease respiratory depth to compensate as needed). This process and other physical responses to compensate for immediate atmosphere changes may be uneventful, go unnoticed and unattended.

However, a 4-6% decline in room air oxygen can become a challenge to a COPD patient whose pulse oximetry on average is 88% or below. This percentage change can occur in many geographic locations and cause a significant burden to COPD patients. Fortunately, a weather forecast indicating a 4-6% drop in local barometric pressure can alert the patient and nurse of the approaching atmospheric change. Note indoor and outdoor barometric pressures remain essentially equal. Therefore, when air pressure changes by 4%-6% occur outdoors, a 4%-6% change in indoor barometric pressure is anticipated. During a 4%-6% barometric pressure change weather sensitive patients may become exacerbation vulnerable. These silent weather challenges can be easily measured and translated into measureable complimentary fortifying treatments. Seasonal intake and/or requirement variations in diet, fluid intake, exercise, clothing, rest, sleep, indoor/outdoor exposures, home environment qualities and socialization patterns are generally not assessed for seasonal compensatory nursing care. Weather-health logs and seasonal diaries can enhance such patient centered care planning. Reports of physical reactions and tolerances to heat, cold, and air quality should be recognized and documented for weather vulnerable populations. Next consider the factor of altitude. When riding in an elevator, driving an automobile from low elevation areas through mountain ranges, or flying in commercial aircraft, the weight of the air and the percentage of room air oxygen changes. For example, as a person moves 30 floors (estimated 300 feet) up or down in an elevator, the person is exposed to approximately a 1% + *down* / -*up* change in room air oxygen (Baillie, J.K., 2007). According to the World Health Organization, international commercial airline flights flying at altitudes of 36,000 to 40,000 feet above sea level generally maintain cabin air pressure equivalent to the air pressure of approximately 6000-8000 feet above sea level (WHO, 2015). Based on a Standard Atmospheric Condition Scale (Federal Aviation

Administration, 2008) values, an airline passengers departing from a sea level location may experience a 20% to 26% drop in the cabin's room air oxygen while traveling between 36,000 to 40,000 feet above sea level (p. 10-3). Tolerance to these exposures may be difficult for persons with a cardiac, stroke, and/or respiratory condition. Airlines will accommodate date healthcare needs based on medical recommendations made and shared in advance of flights.

The presence of nurses in homes, schools, occupational settings, clinics, hospitals and long term care agencies positions nurses to deliver seasonal and day to day protective care, preventative care, and self-care health behaviors support. A more extensive understanding of the seasonal health behaviors and nursing interventions to offset changes in room air and outdoor exposures is indicated. Knowledge of internal body fluid shifts during barometric pressure changes, seasonal and time of day variations in vital sign management, and hydration shifts associated with weather changes are content areas significant to nursing care designed to maintaining patient wellness and mitigate bio-meteorological exposure risk.

## Conclusion

In summary, bio-meteorological pre-symptom time markers are scientific discoveries key to reducing cardiac, respiratory, stroke, and diabetic exacerbations antecedent to the current high incidence of non-communicable global mortality and morbidity. Nurse use of bio-meteorological pre-symptom time markers will prompt needed timely early protective and preventative nursing care delivery for cardiac, stroke, respiratory, and diabetic populations. Therefore, accentuation of weather-health nursing in global healthcare delivery is needed. International evidence strongly indicates bio-meteorological periods of vulnerability which are repetitively seasonal and have real-time repetitive concurrency among cardiac, stroke, respiratory and diabetic populations with in northern and southern hemisphere countries studied. Extending periods of wellness and decreasing the severity and frequency of exacerbations in cardiac, stroke, respiratory, and diabetic populations involve life style choices, adherence to care regimes and timely health fortification. Nursing services address life style choices, adherence to prescribed care regimes, and health fortification behaviors. Lacking was awareness of the degree seasonality and weather-health vulnerability associate with cardiac, stroke, respiratory, and diabetic: vulnerability, mortality, and morbidity. Finally, integration of weather-health dynamics into nursing practice, education, and research is both logical and strategic. Weather vulnerable periods can be identified, forecast in advance and included to nurse assessment, planning, implementation, and evaluation. Bio-meteorological variables can be described and measured facilitating quantitative and replicable investigations. Hence the adoption and further study of bio-meteorological pre-symptom time markers lays the foundation for weather-health nursing and a shift from symptoms driven in care actions to a pre-symptom protection/prevention paradigm.

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